



November 7, 2011

Mr. Tom Gainer  
Oregon Department of Environmental Quality  
2020 SW Fourth Avenue, Suite 400  
Portland, OR 97201-4987

**Subject:** **Revised Upland Feasibility Study**  
**Terminal 4 Slip 1 Upland Facility (ECSI No. 2365)**  
**Response to DEQ Comments dated October 13, 2011**

Dear Tom:

The purpose of this letter is to provide the Oregon Department of Environmental Quality (DEQ) with a response to comments received in a letter dated October 13, 2011 on the above referenced report. DEQ comments and the Port's responses are presented below.

***DEQ Comment 1: Sections 8.0 and 9.2 The description of the “Institutional Controls with Future Development” alternative includes a statement that future use of the planned remedial action areas will require redevelopment (Section 9.2, top of page 21). DEQ wants to be clear that the planned remedial action areas must not be used by occupational workers without redevelopment. In this case, redevelopment means soil excavation, capping, or paving, even if new buildings are not needed by the new site user. The final remedy would not allow new tenants to occupy remedial action areas with elevated surface soil contamination by “keeping workers away” from these areas, but must instead prevent the complete exposure pathway via redevelopment defined above. For Section 11.1, DEQ views this remedial alternative as capping (different from that described in Section 9.3), with remedial design and implementation to be determined in the future when new tenants are identified.***

**Response:** The Port concurs with the DEQ's views as stated in the comment with the following clarifying points.

- The Port acknowledges that the selected alternative is viewed as primarily a capping alternative with the understanding that the alternative includes soil removal as needed to accommodate future site redevelopment.
- Site redevelopment (and hence remedial design and implementation) may occur in phases as needed to accommodate tenants. This means that it is possible that only a portion of Terminal 4 would be leased to a new tenant. All remedial action areas within the leased space would be capped, paved, or excavated/removed prior to occupation by the tenant. Existing and new tenants would not be allowed to occupy undeveloped areas.

***DEQ Comment 2: Section 11.2 Tables 4 and 5 provide summary data on the samples outside of and within the managed areas of OU1. The results appear reasonable, but please provide a spreadsheet with sample data and UCL calculations so DEQ can confirm the evaluation.***

***As presented in Oregon rule [OAR 340-122-0084(4)], a residual risk assessment must accomplish two goals: 1) a quantitative assessment of the risk resulting from concentrations of chemicals remaining at the site, and 2) a qualitative or quantitative assessment of the adequacy and reliability of any institutional or engineering controls used to manage exposure to chemicals remaining at the site. The evaluation summarized in Tables 4 and 5 accomplishes the first goal. However, the residual risk assessment does not include an assessment of the adequacy and reliability of the recommended institutional controls with future redevelopment (see comment above); such discussion should be added. At the time the specific details of site redevelopment are planned, there must be an evaluation of the adequacy and reliability of the recommended action. This evaluation will complete the residual risk assessment.***

**Response:** Attachment A includes supporting documentation for the residual risk calculations. There are subtle differences between the calculations attached and Table 4 from the FS based on how the non-detect values were handled. Also, in Table 5 it was noted that the reported mean value for benzo(b)fluoranthene was actually the median and not the mean. These differences result in no substantive changes in the residual risk calculations. The attachment includes the following:

- Data tables from the RI and subsequent surface soil sampling;
- Data tables consolidating the surface soil data applicable to the residual risk calculations;
- Input files for the ProUCL 90% UCL calculations; and
- Output files from the ProUCL 90% UCL calculations.

A qualitative assessment of the adequacy/reliability of institutional or engineering controls was completed (as applicable) in the detailed analysis of each alternative in Section 9 [as required by OAR 340-122-0090(3)(a)(B)]. Reference to that part of the residual risk assessment was inadvertently left out of Section 11.2. In summary, the qualitative assessment of institutional/engineering controls included the following:

- In accordance with recently implemented rules from Homeland Security, access to all Port facilities, including Terminal 4, is strictly controlled. The facilities are fenced and access is through a gated entrance manned full-time by security personnel.
- The soil management plan will delineate remedial action areas, identify appropriate soil-handling and protective measures for construction activities within the remedial action areas at the Facility, and identify inspection and maintenance requirements for capped areas.
- Redevelopment will include one or more of soil excavation, filling, paving, or building construction. These elements will serve to reduce potential risk by either removing the soil with PAHs or serving as a cap to prevent contact by occupational workers.

The Port acknowledges that future redevelopment plans must be evaluated for adequacy and reliability of protection provided by the redevelopment.

Please call me at (503) 415-6676 if you have any questions.

Sincerely,



Kelly Madalinski  
Environmental Project Manager

ATTACHMENTS:

Attachment A - Residual Risk Calculation Supporting Documentation

c: Kristine Koch, EPA  
Rich Muza, EPA  
Dennis Klein, Cargill Inc.  
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Gene Loffler, CLD PacificGrain, LLC  
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David Breen, Port  
Jessica Hamilton, Port  
Michael Pickering, Ash Creek Associates  
Mark Lewis, Formation Environmental  
LWP File

## ***Attachment A***

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### **Residual Risk Calculation Supporting Documentation**

## **RI and Post-RI Surface Soil Sampling Data Tables**

**TABLE 7A**  
**SOIL CHEMISTRY RESULTS: POLYNUCLEAR AROMATIC HYDROCARBONS - OU1**

**REMEDIAL INVESTIGATION**  
**PORT OF PORTLAND - TERMINAL 4 SLIP 1**

Sample Location:	Preliminary Screening Levels		T4S1SB-9	T4S1SB-14	T4S1SB-15	T4S1SB-16	T4S1SB-17	T4S1SB-18	T4S1SB-21	T4S1SB-22	T4S1SB-22	T4S1SB-23
	Sample ID:	Sample Interval:	T4S1SB-9-0-1 0 - 1 9/2/2004	T4S1SB-14-1-1 1 - 2 8/24/2004	T4S1SB-15-1-1 1 - 2 9/3/2004	T4S1SB-16-1-1 0.5 - 1.5 9/3/2004	T4S1SB-17-1-1 1 - 2 9/7/2004	T4S1SB-18-1-1 1 - 1.5 9/2/2004	T4S1SB-21-13-1 12.5 - 14 9/2/2004	T4S1SB-22-13-1 12.5 - 14 9/2/2004	T4S1SB-22-17-1 16.5 - 17 9/2/2004	T4S1SB-23-13-1 12.5 - 14 9/2/2004
<b>PAHs (µg/kg)</b>												
Naphthalene	190,000	10,000	3.1 J	10	2.8 J	2.4 J	2.1 J	20	2 J	12	2,100 D	220
2-Methylnaphthalene	--	--	1.5 J	6.8	1.4 J	1.5 J	1.4 J	18	1.7 J	4.2 J	740 D	210
Acenaphthylene	--	--	1.7 J	50	3.5 J	3.2 J	3.8 J	13	0.3 J	18	2,700 D	350
Acenaphthene	29,000,000	20,000	0.33 J	11	0.56 J	0.72 J	1.1 J	1.9 J	3.9 U	1.1 J	1,200 D	290
Fluorene	26,000,000	30,000	0.57 J	8.2	0.51 J	0.63 J	1.5 J	1.8 J	0.33 J	7.6	3,500 D	630
Dibenzofuran	3,100,000	2	0.49 J	7.5	0.54 J	0.75 J	0.37 J	5.5	0.31 J	4.9 J	1,300 D	100
Phenanthrene	--	--	4.8	260	7.9	7.3	30	51	1.1 J	100	27,000 D	3,800 D
Anthracene	100,000,000	--	2.6 J	68	4.4 J	5	9.3	19	0.33 J	14	5,400 D	1,000
Fluoranthene	22,000,000	--	11	520	18	15	39	120	0.91 J	140	43,000 D	3,500 D
Pyrene	29,000,000	--	14	560	25	20	60	130	1.2 J	150	44,000 D	4,400 D
Benzo(b)fluoranthene	2,100	--	7	320	15	16	14	78	3.9 U	61	14,000 D	1,200
Benzo(k)fluoranthene	21,000	--	12	260	13	12	15	91	3.9 U	80	16,000 D	1,000
Benzo(a)anthracene	2,100	--	5.5	210	11	9	24	59	0.33 J	64	16,000 D	1,500
Chrysene	210,000	--	11	340	17	15	27	96	3.9 U	81	21,000 D	1,800
Benzo(a)pyrene	210	125,000	6.1	320	8.9	12	15	84	0.38 J	92	17,000 D	1,400
Indeno(1,2,3-cd)pyrene	2,100	--	9.5	330	15	15	12	82	0.37 J	63	12,000 D	1,000
Dibenz(a,h)anthracene	210	--	2 J	53	2.6 J	2.7 J	2.6 J	12	3.9 U	11	2,500 D	210
Benzo(g,h,i)perylene	--	--	9.7	320	17	16	12	100	0.49 J	60	11,000 D	950

Sample Location:	Preliminary Screening Levels		T4S1SB-24	T4S1SB-31	T4S1SB-32	T4S1SB-33	T4S1SB-42	T4S1SB-45	T4S1SB-46	T4S1SB-47	T4S1SB-48	T4S1SB-49
	Sample ID:	Sample Interval:	T4S1SB-24-13-1 12 - 13 8/25/2004	T4S1SB-31-0-1 0.5 - 1.5 9/8/2004	T4S1SB-32-0-1 0.5 - 1.5 9/3/2004	T4S1SB-33-0-1 0.25 - 1 9/3/2004	T4S1SB-42-1-1 0.5 - 1.5 9/3/2004	T4S1SB-45-1-1 0.5 - 2 9/3/2004	T4S1SB-46-1-1 0.5 - 2 8/23/2004	T4S1SB-47-1-1 0.5 - 2 8/23/2004	T4S1SB-48-1-1 0.5 - 2 8/23/2004	T4S1SB-49-1-1 0.5 - 2 8/23/2004
<b>PAHs (µg/kg)</b>												
Naphthalene	190,000	10,000	6.2	33	1.3 J	9.9	2.6 J	36	1.2 J	1.4 J	1.4 J	1.4 J
2-Methylnaphthalene	--	--	0.98 J	50	0.66 J	15	1.4 J	37	0.76 J	0.91 J	0.92 J	0.84 J
Acenaphthylene	--	--	2 J	14	5 U	7.7	13	27	0.59 J	0.27 J	0.52 J	5 U
Acenaphthene	29,000,000	20,000	0.33 J	1.7 J	5 U	0.78 J	1.2 J	1.8 J	4.9 U	4.9 U	4.9 U	5 U
Fluorene	26,000,000	30,000	0.68 J	2.7 J	5 U	1.4 J	0.66 J	4.2 J	4.9 U	4.9 U	4.9 U	5 U
Dibenzofuran	3,100,000	2	0.64 J	21	5 U	4 J	0.94 J	9.8	4.9 U	4.9 U	--	--
Phenanthrene	--	--	1.8 J	66	0.66 J	46	17	110	1.2 J	0.79 J	1.3 J	0.87 J
Anthracene	100,000,000	--	0.41 J	20	5 U	9.4	12	32	0.78 J	0.32 J	0.51 J	5 U
Fluoranthene	22,000,000	--	1.5 J	73	1.3 J	48	62	280	3.4 J	1.9 J	2.2 J	1.7 J
Pyrene	29,000,000	--	1.4 J	110	1.5 J	72	82	360	4.8 J	2.5 J	2.6 J	1.7 J
Benzo(b)fluoranthene	2,100	--	4.9 U	140	1 J	61	58	230	2.1 J	1.4 J	1.4 J	1.4 J
Benzo(k)fluoranthene	21,000	--	4.9 U	67	0.66 J	49	45	170	1.7 J	1.1 J	0.85 J	0.9 J
Benzo(a)anthracene	2,100	--	0.46 J	66	0.98 J	38	58	150	2.1 J	1.6 J	0.89 J	1.4 J
Chrysene	210,000	--	4.9 U	150	0.91 J	63	69	230	2.2 J	1.5 J	1.4 J	1.2 J
Benzo(a)pyrene	210	125,000	0.66 J	97	0.65 J	58	53	250	1.8 J	1.4 J	1.2 J	1.1 J
Indeno(1,2,3-cd)pyrene	2,100	--	1.1 J	84	0.92 J	61	39	280	3 J	1.7 J	1.9 J	1.4 J
Dibenz(a,h)anthracene	210	--	4.9 U	24	5 U	13	9.6	39	0.54 J	0.37 J	0.3 J	5 U
Benzo(g,h,i)perylene	--	--	1.1 J	110	0.87 J	67	40	290	3.1 J	1.8 J	2.3 J	1.4 J

Please refer to notes at end of table.

**TABLE 7A**  
**SOIL CHEMISTRY RESULTS: POLYNUCLEAR AROMATIC HYDROCARBONS - OU1**

**REMEDIAL INVESTIGATION  
 PORT OF PORTLAND - TERMINAL 4 SLIP 1**

Sample Location:	Screening Levels		T4S1SB-50	T4S1SB-82	T4S1SB-83	T4S1SB-84	T4S1SB-88	T4S1SB-89	T4S1SB-90
Sample ID:	PRG	SLV	T4S1SB-50-1-1	T4S1SB-82-1-1	T4S1SB-83-1-1	T4S1SB-84-13-1	T4S1SB-88-7.5-1	T4S1SB-89-0-1	T4S1SB-90-0-1
Sample Interval:	0.5 - 2.5		0.5 - 1.5	0.5 - 1.5	1 - 2	12 - 13.5	7.5 - 10	0.5 - 2.5	1 - 3
Date Sampled:			8/23/2004	9/1/2004	9/1/2004	9/8/2004	9/7/2005	9/7/2005	9/7/2005
<b>PAHs (µg/kg)</b>									
Naphthalene	190,000	10,000	1.1 J	2.7 J	1.9 J	1.3 J	7.19 U, D	15.2 U	14.4 U
2-Methylnaphthalene	--	--	0.64 J	1.6 J	0.78 J	1.1 J	--	--	--
Acenaphthylene	--	--	0.46 J	2.3 J	0.47 J	0.65 J	7.19 U, D	15.2 U	14.4 U
Acenaphthene	29,000,000	20,000	5 U	2.2 J	4.9 U	0.28 J	7.19 U, D	15.2 U	14.4 U
Fluorene	26,000,000	30,000	5 U	1.4 J	0.36 J	0.43 J	7.19 U, D	15.2 U	14.4 U
Dibenzofuran	3,100,000	2	5 U	0.74 J	0.23 J	5 U	--	--	--
Phenanthrene	--	--	0.56 J	12	1.3 J	5.5	68.8 D	7.65 J	14.4 U
Anthracene	100,000,000	--	0.65 J	4.8 J	0.81 J	2.1 J	9.78 J, D	15.2 U	14.4 U
Fluoranthene	22,000,000	--	1.5 J	35	2.7 J	7.7	58.0 D	15.3 D	3.80 J, D
Pyrene	29,000,000	--	1.7 J	34	3.8 J	11	51.3 D	24.7 D	7.79 J, D
Benzo(b)fluoranthene	2,100	--	1.8 J	24	1.5 J	3 J	34.8 D	18.9 D	4.00 J, D
Benzo(k)fluoranthene	21,000	--	1.1 J	31	2.7 J	4.1 J	28.3 J	13.9 J, D	14.4 U
Benzo(a)anthracene	2,100	--	1.3 J	15	1.5 J	5.4	34.7 D	10.1 J, D	14.4 U
Chrysene	210,000	--	1.3 J	28	2.7 J	5.7	50.4 D	21.4 D	3.84 J, D
Benzo(a)pyrene	210	125,000	1.2 J	21	2.6 J	3.3 J	35.8 J	16.9 D	4.86 J, D
Indeno(1,2,3-cd)pyrene	2,100	--	2 J	28	2.8 J	2.7 J	15.7 J	8.80 J, D	14.4 U
Dibenz(a,h)anthracene	210	--	5 U	5.9	4.9 U	0.57 J	7.19 U, D	15.2 U	14.4 U
Benzo(g,h,i)perylene	--	--	2.3 J	26	3.5 J	2.6 J	18.2 J, D	11.0 J, D	3.68 J, D

Sample Location:	Screening Levels		T4S1SB-92	T4S1SB-93	T4S1SB-94	T4S1SB-95	T4S1S-5	T4S1S-6	T4S1S-7	T4S1S-11
Sample ID:	PRG	SLV	T4S1SB-92-0-1	T4S1SB-93-0-1	T4S1SB-94-0-1	T4S1SB-95-0-1	T4S1S-5	T4S1S-6	T4S1S-7	T4S1S-11
Sample Interval:	1 - 3		0.5 - 2.5		1 - 3	0.5 - 2.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Date Sampled:			9/7/2005	9/7/2005	9/7/2005	9/7/2005	9/7/2005	3/22/2005	3/22/2005	3/22/2005
<b>PAHs (µg/kg)</b>										
Naphthalene	190,000	10,000	3.49 J, D	7.47 U, D	5.75 J, D	12.0 J, D	330 U, J	330 U, J	91 J	7.9
2-Methylnaphthalene	--	--	--	--	--	--	330 U, J	330 U, J	65 J	5.3
Acenaphthylene	--	--	5.88 J, D	7.47 U, D	3.53 U	11.2 J, D	330 U, J	330 U, J	97 J	11
Acenaphthene	29,000,000	20,000	20.2 D	7.47 U, D	3.53 U	34.9 D	340 U, J	340 U, J	350 J	14
Fluorene	26,000,000	30,000	8.27 J, D	7.47 U, D	3.53 U	14.3 D	340 U, J	340 U, J	180 J	6.4
Dibenzofuran	3,100,000	2	--	--	--	--	340 U, J	340 U, J	100 J	4.4 J
Phenanthrene	--	--	105 D	15.8 J, D	17.4 D	212 D	47 J	100 J	1,700 J	90
Anthracene	100,000,000	--	26.3 D	7.47 U, D	4.92 J, D	41.7 D	30 J	24 J	390 J	31
Fluoranthene	22,000,000	--	263 D	41.9 D	34.8 D	520 D	26 J	110 J	3,100	290
Pyrene	29,000,000	--	309 D	40.5 D	37.5 D	650 D	77 J	170 J	2,700	290
Benzo(b)fluoranthene	2,100	--	326 D	59.5 J	40.6 J	644 D	92 J	210 J	3,800	310
Benzo(k)fluoranthene	21,000	--	248 D	33.6 J	24.9 J	480 D	31 J	85 J	1,100 J	300
Benzo(a)anthracene	2,100	--	201 D	31.2 D	19.8 D	383 D	52 J	100 J	2,200	190
Chrysene	210,000	--	238 D	43.3 D	34.8 D	474 D	69 J	140 J	2,500	250
Benzo(a)pyrene	210	125,000	281 D	47.8 J	32.1 J	568 D	69 J	150 J	2,800	310
Indeno(1,2,3-cd)pyrene	2,100	--	121 D	25.3 J	25.8 J	242 D	64 J	130 J	2,500	390
Dibenz(a,h)anthracene	210	--	43.9 D	12.0 J	7.03 J, D	84.7 D	330 U	35 J	660	77
Benzo(g,h,i)perylene	--	--	133 D	28.1 J	34.1 J	258 D	93 J	140 J	2,600	380

Please refer to notes at end of table.

**TABLE 7A**  
**SOIL CHEMISTRY RESULTS: POLYNUCLEAR AROMATIC HYDROCARBONS - OU1**

**REMEDIAL INVESTIGATION  
 PORT OF PORTLAND - TERMINAL 4 SLIP 1**

Sample Location:	Preliminary Screening Levels		T4S1S-12	T4S1S-12	T4S1S-12	T4S1S-13	T4S1S-13	T4S1S-13	T4S1S-15	T4S1S-16	T4S1S-17	T4S1S-18	T4S1S-19
Sample ID:	PRG	SLV	T4S1S-12	T4S1S-12-0.5	T4S1S-12-2	T4S1S-13	T4S1S-13-0.5	T4S1S-13-2	T4S1S-15-0.5	T4S1S-16-0.5	T4S1S-17-0.5	T4S1S-18-0.5	T4S1S-19-0.5
Sample Interval:	0 - 0.5	0.5 - 1	2 - 2.5	0 - 0.5	0.5 - 1	2 - 2.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Date Sampled:	3/22/2005	9/6/2005	3/22/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005
<b>PAHs (µg/kg)</b>													
Naphthalene	190,000	10,000	76	24.9 J, D	14.2 U	28	40.2 J, D	69.6 U	17.5 U, D	140 U	71.8 U	14.2 U	70.8 U
2-Methylnaphthalene	--	--	42	--	--	16	--	--	--	--	--	--	--
Acenaphthylene	--	--	29	61.3 J, D	14.2 U	31	223 D	69.6 U	29 J, D	140 U	56.8 J, D	14.2 U	37.4 J, D
Acenaphthene	29,000,000	20,000	340	112 D	14.2 U	200	114 J, D	69.6 U	37.1 J, D	53.5 J, D	37.8 J, D	7.32 J, D	17.6 J, D
Fluorene	26,000,000	30,000	110	44.9 J, D	14.2 U	65	82.3 J, D	69.6 U	22.6 J, D	140 U	21.5 J, D	14.2 U	70.8 U
Dibenzofuran	3,100,000	2	62	--	--	36	--	--	--	--	--	--	--
Phenanthrene	--	--	2,000 D	588 D	6.75 J, D	1,300 D	677 D	87.9 D	258 D	313 D	203 D	37.6 D	136 D
Anthracene	100,000,000	--	350	179 D	14.2 U	220	627 D	40.6 J, D	78 D	66.1 J, D	115 D	8.62 J, D	50.2 J, D
Fluoranthene	22,000,000	--	6,400 D	1,460 D	20.6 D	3,900 D	1,860 D	275 D	667 D	853 D	490 D	88.8 D	359 D
Pyrene	29,000,000	--	5,800 D	1,380 D	18.3 D	3,800 D	1,810 D	225 D	734 D	900 D	552 D	99.2 D	456 D
Benzo(b)fluoranthene	2,100	--	6,200 D	1,830 D	20.9 D	3,900 D	3,060 D	323 J	616 D	1,080 D	631 D	79.5 D	342 D
Benzo(k)fluoranthene	21,000	--	4,200 D	1,150 D	16.3 D	3,300 D	1,810 D	213 J	627 D	695 D	604 D	85.1 D	378 D
Benzo(a)anthracene	2,100	--	3,900 D	998 D	14.1 J, D	2,400 D	1,300 D	185 D	446 D	581 D	358 D	57.3 D	249 D
Chrysene	210,000	--	4,900 D	1,380 D	20.1 D	3,200 D	1,780 D	228 D	585 D	789 D	467 D	72.0 D	335 D
Benzo(a)pyrene	210	125,000	6,000 D	1,310 D	20.1 D	3,800 D	1,760 D	256 J	616 D	830 D	571 D	83.8 D	354 D
Indeno(1,2,3-cd)pyrene	2,100	--	5,400 D	491 D	16.2 D	3,700 D	1,410 D	210 J	344 D	403 D	290 D	41.3 D	185 D
Dibenz(a,h)anthracene	210	--	1,100	166 D	5.04 J, D	780	500 D	70.1 J	117 D	142 D	99.4 D	14.5 D	61.6 J, D
Benzo(g,h,i)perylene	--	--	5,000 D	445 D	20.1 D	3,400 D	1,340 D	232 J	372 D	416 D	294 D	44.6 D	206 D

**Notes:**

- Only detected compounds are reported in the table. The complete analyte list is presented in the Sampling and Analysis Plan (Appendix A) of the RI Work Plan (Hart Crowser, 2004a).
  - PAHs = Polynuclear Aromatic Hydrocarbons by EPA Method 8270C (SIM).
  - µg/kg = Micrograms per kilogram.
  - PRG = EPA Region 9 Preliminary Remediation Goal (PRG) for Industrial Soil (October 2004).
  - = No screening level available or not analyzed.
  - J = The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method detection limit (MDL).
  - U = The compound was analyzed for but was not detected at or above the MRL/MDL.
  - D = Dilution.
  - Shaded values indicate that the detected concentration exceeds the PRG.
  - Sample ID nomenclature is per the following: type of sample-sample number-depth in feet-designation.
- For example T4S1SB-46-1-1 = soil boring (SB) number 46, collected 1 foot below the ground surface, primary sample (1). T4S1S-6 = surface soil sample number 6.
- SLV = Oregon Department of Environmental Quality Level II Screening Level Values (SLVs) for Terrestrial Receptors (lowest available value).
  - Boxed values indicate that the detected concentration exceeds the SLV (only samples from 0 to 3 feet were screened against the SLV).

**Table 1**

**Soil Analytical Results: PAHs**  
**Terminal 4 Slip 1 Upland Facility**  
**Portland, Oregon**

Sample ID: Sampling Interval (inches): Sample Date:	February 2010 Surface Soil Sampling									Pipeline Rack Investigation					
	SS-1-1 6 - 12 2/17/2010	SS-2-1 6 - 12 2/17/2010	SS-3-1 6 - 12 2/17/2010	SS-4-1 11 - 16 2/17/2010	SS-5-1 8 - 12 2/17/2010	SS-6-1 12 - 16 2/17/2010	SS-7-1 6 - 12 2/17/2010	SS-8-1 6 - 12 2/17/2010	SS-8-2 12 - 18 2/17/2010	PL-1-1 26 - 32 5/11/2009	PL-2-1 16 - 22 5/11/2009	PL-3-1 32 - 36 5/11/2009	PL-4-1 24 - 30 5/11/2009	PL-5-1 26 - 32 5/11/2009	PL-6-1 19 - 25 5/11/2009
	PAHs (ug/kg)														
Acenaphthene	22.0	4.7 J	3.3 J	<7.2	3.5 J	<7.4	7.9	481	2,890	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Acenaphthylene	7.6	25.6	10.2	0.81 J	4.2 J	5.9 J	45.4	56.1	56.0	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Anthracene	25.4	18.8	11.8	1.1 J	5.3 J	6.2 J	30.6	308	1,740	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Benzo(a)anthracene	176	93.4	46.6	5.4 J	34.0	31.5	85.4	2,320	14,200	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Benzo(a)pyrene	252	154	72.5	7.5	52.9	43.6	170	2,800	19,200	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Benzo(b)fluoranthene	237	123	67.8	5.7 J	54.9	33.6	171	2,900	20,200	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Benzo(g,h,i)perylene	203	143	69.5	7.8	46.8	38.5	175	1,810	14,300	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Benzo(k)fluoranthene	211	113	53.3	5.5 J	31.3	29.9	104	2,150	14,300	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Chrysene	193	121	53.5	7.2	39.9	34.0	100	2,440	15,300	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Dibenz(a,h)anthracene	58.9	31.3	16.2	1.7 J	12.2	7.6	45.0	602	5,010	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Dibenzofuran	--	--	--	--	--	--	--	--	--	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Fluoranthene	267	182	70.6	7.0 J	52.5	58.4	129	4,210	26,400	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Fluorene	10.0	5.6 J	3.0 J	<7.2	2.7 J	<7.4	8.5	371	2,000	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Indeno(1,2,3-cd)pyrene	178	116	57.2	5.6 J	37.8	29.7	147	1,810	13,300	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
1-Methylnaphthalane	4.5 J	3.0 J	4.9 J	3.9 J	1.5 J	1.3 J	5.8 J	70.1	414	--	--	--	--	--	--
2-Methylnaphthalane	7.9	7.0 J	8.0	13.2	2.7 J	2.9 J	10.7	139	825	--	--	--	--	--	--
Naphthalene	9.8	14.2	9.5	7.2	3.6 J	6.1 J	15.7	205	1,130	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Phenanthrene	107	84.4	26.4	<7.2	19.2	23.9	57.8	2,250	14,100	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6
Pyrene	232	199	74.2	8.5	55.2	63.8	139	3,320	20,100	<14.7	<14.9	<15.1	<14.8	<14.8	<14.6

**Notes:**

1. PAHs = Polynuclear aromatic hydrocarbons (PAHs) by EPA Method 8270M-SIM.
2. µg/kg (ppb) = Micrograms per kilogram (parts per billion).
3. < = Not detected above the method reporting limit (MRL).
4. Remedial Action Objectives (RAOs) from DRAFT Feasibility Study (Ash Creek, 2008):
  - Benzo(a)pyrene = 270 µg/kg
  - Benzo[a]anthracene = 2,700 µg/kg
  - Benzo[b]fluoranthene = 2,700 µg/kg
  - Dibenz(a,h)anthracene = 270 µg/kg
  - Indeno[1,2,3-cd]pyrene = 2,700 µg/kg
5. -- = Not analyzed.
6. Shading indicates a detected concentration that exceeds the RAO
7. J = Estimated concentration above the method detection limit and below the MRL

## **Data Tables Applicable to Residual Risk Calculations**

**Residual Risk Calculation Data Supporting FS Table 4**

**Benzo(a)anthracene**

Sample Location	µg/kg	Note
PL-1-1	14.7	0
PL-2-1	14.9	0
PL-3-1	15.1	0
PL-4-1	14.8	0
PL-5-1	14.8	0
PL-6-1	14.6	0
SS-1-1	176	1
SS-2-1	93.4	1
SS-3-1	46.6	1
SS-4-1	5.4	1
SS-5-1	34.0	1
SS-6-1	31.5	1
SS-7-1	85.4	1
T4S1S-11	190	1
T4S1S-5	52	1
T4S1S-6	100	1
T4S1SB-14	210	1
T4S1SB-15	11	1
T4S1SB-16	9	1
T4S1SB-17	24	1
T4S1SB-18	59	1
T4S1SB-31	66	1
T4S1SB-33	38	1
T4S1SB-42	58	1
T4S1SB-45	150	1
T4S1SB-46	2.1	1
T4S1SB-47	1.6	1
T4S1SB-48	0.89	1
T4S1SB-49	1.4	1
T4S1SB-50	1.3	1
T4S1SB-82	15	1
T4S1SB-83	1.5	1
T4S1SB-89	10.1	1
T4S1SB-9	5.5	1
T4S1SB-90	14.4	0
T4S1SB-92	201	1
T4S1SB-93	31.2	1
T4S1SB-94	19.8	1
T4S1SB-95	383	1

**Benzo(b)fluoranthene**

Sample Location	µg/kg	Note
PL-1-1	14.7	0
PL-2-1	14.9	0
PL-3-1	15.1	0
PL-4-1	14.8	0
PL-5-1	14.8	0
PL-6-1	14.6	0
SS-1-1	237	1
SS-2-1	123	1
SS-3-1	67.8	1
SS-4-1	5.7	1
SS-5-1	54.9	1
SS-6-1	33.6	1
SS-7-1	171	1
T4S1S-11	310	1
T4S1S-5	92	1
T4S1S-6	210	1
T4S1SB-14	320	1
T4S1SB-15	15	1
T4S1SB-16	16	1
T4S1SB-17	14	1
T4S1SB-18	78	1
T4S1SB-31	140	1
T4S1SB-33	61	1
T4S1SB-42	58	1
T4S1SB-45	230	1
T4S1SB-46	2.1	1
T4S1SB-47	1.4	1
T4S1SB-48	1.4	1
T4S1SB-49	1.4	1
T4S1SB-50	1.8	1
T4S1SB-82	24	1
T4S1SB-83	1.5	1
T4S1SB-89	18.9	1
T4S1SB-9	7	1
T4S1SB-90	4.00	1
T4S1SB-92	326	1
T4S1SB-93	59.5	1
T4S1SB-94	40.6	1
T4S1SB-95	644	1

**Benzo(a)pyrene**

Sample Location	µg/kg	Note
PL-1-1	14.7	0
PL-2-1	14.9	0
PL-3-1	15.1	0
PL-4-1	14.8	0
PL-5-1	14.8	0
PL-6-1	14.6	0
SS-1-1	252	1
SS-2-1	154	1
SS-3-1	72.5	1
SS-4-1	7.5	1
SS-5-1	52.9	1
SS-6-1	43.6	1
SS-7-1	170	1
T4S1S-11	310	1
T4S1S-5	69	1
T4S1S-6	150	1
T4S1SB-14	320	1
T4S1SB-15	8.9	1
T4S1SB-16	12	1
T4S1SB-17	15	1
T4S1SB-18	84	1
T4S1SB-31	97	1
T4S1SB-33	58	1
T4S1SB-42	53	1
T4S1SB-45	250	1
T4S1SB-46	1.8	1
T4S1SB-47	1.4	1
T4S1SB-48	1.2	1
T4S1SB-49	1.1	1
T4S1SB-50	1.2	1
T4S1SB-82	21	1
T4S1SB-83	2.6	1
T4S1SB-89	16.9	1
T4S1SB-9	6.1	1
T4S1SB-90	4.86	1
T4S1SB-92	281	1
T4S1SB-93	47.8	1
T4S1SB-94	32.1	1
T4S1SB-95	568	1

**Indeno(1,2,3-cd)pyrene**

Sample Location	µg/kg	Note
PL-1-1	14.7	0
PL-2-1	14.9	0
PL-3-1	15.1	0
PL-4-1	14.8	0
PL-5-1	14.8	0
PL-6-1	14.6	0
SS-1-1	178	1
SS-2-1	116	1
SS-3-1	57.2	1
SS-4-1	5.6	1
SS-5-1	37.8	1
SS-6-1	29.7	1
SS-7-1	147	1
T4S1S-11	390	1
T4S1S-5	64	1
T4S1S-6	130	1
T4S1SB-14	330	1
T4S1SB-15	15	1
T4S1SB-16	15	1
T4S1SB-17	12	1
T4S1SB-18	82	1
T4S1SB-31	84	1
T4S1SB-33	61	1
T4S1SB-42	39	1
T4S1SB-45	280	1
T4S1SB-46	3	1
T4S1SB-47	1.7	1
T4S1SB-48	1.9	1
T4S1SB-49	1.4	1
T4S1SB-50	2	1
T4S1SB-82	28	1
T4S1SB-83	2.8	1
T4S1SB-89	8.80	1
T4S1SB-9	9.5	1
T4S1SB-90	14.4	0
T4S1SB-92	121	1
T4S1SB-93	25.3	1
T4S1SB-94	25.8	1
T4S1SB-95	242	1

**Dibenz(a,h)anthracene**

Sample Location	µg/kg	Note
PL-1-1	14.7	0
PL-2-1	14.9	0
PL-3-1	15.1	0
PL-4-1	14.8	0
PL-5-1	14.8	0
PL-6-1	14.6	0
SS-1-1	58.9	1
SS-2-1	31.3	1
SS-3-1	16.2	1
SS-4-1	1.7	1
SS-5-1	12.2	1
SS-6-1	7.6	1
SS-7-1	45.0	1
T4S1S-11	77	1
T4S1S-5	330	0
T4S1S-6	35	1
T4S1SB-14	53	1
T4S1SB-15	2.6	1
T4S1SB-16	2.7	1
T4S1SB-17	2.6	1
T4S1SB-18	12	1
T4S1SB-31	24	1
T4S1SB-33	13	1
T4S1SB-42	9.6	1
T4S1SB-45	39	1
T4S1SB-46	0.54	1
T4S1SB-47	0.37	1
T4S1SB-48	0.3	1
T4S1SB-49	5	0
T4S1SB-50	5	0
T4S1SB-82	5.9	1
T4S1SB-83	4.9	0
T4S1SB-89	15.2	0
T4S1SB-9	2	1
T4S1SB-90	14.4	0
T4S1SB-92	43.9	1
T4S1SB-93	12.0	1
T4S1SB-94	7.03	1
T4S1SB-95	84.7	1

**Managed Risk Calculation Data Supporting FS Table 5**

**Benzo(a)anthracene**

Sample Location	µg/kg	Note
SS-8-1	2,320	1
SS-8-2	14,200	1
T4S1S-12	3,900	1
T4S1S-12	998	1
T4S1S-12	14.1	1
T4S1S-13	2,400	1
T4S1S-13	1,300	1
T4S1S-13	185	1
T4S1S-15	446	1
T4S1S-16	581	1
T4S1S-17	358	1
T4S1S-18	57.3	1
T4S1S-19	249	1
T4S1S-7	2,200	1

**Benzo(b)fluoranthene**

Sample Location	µg/kg	Note
SS-8-1	2,900	1
SS-8-2	20,200	1
T4S1S-12	6,200	1
T4S1S-12	1,830	1
T4S1S-12	20.9	1
T4S1S-13	3,900	1
T4S1S-13	3,060	1
T4S1S-13	323	1
T4S1S-15	616	1
T4S1S-16	1,080	1
T4S1S-17	631	1
T4S1S-18	79.5	1
T4S1S-19	342	1
T4S1S-7	3,800	1

**Benzo(a)pyrene**

Sample Location	µg/kg	Note
SS-8-1	2,800	1
SS-8-2	19,200	1
T4S1S-12	6,000	1
T4S1S-12	1,310	1
T4S1S-12	20.1	1
T4S1S-13	3,800	1
T4S1S-13	1,760	1
T4S1S-13	256	1
T4S1S-15	616	1
T4S1S-16	830	1
T4S1S-17	571	1
T4S1S-18	83.8	1
T4S1S-19	354	1
T4S1S-7	2,800	1

**Indeno(1,2,3-cd)pyrene**

Sample Location	µg/kg	Note
SS-8-1	1,810	1
SS-8-2	13,300	1
T4S1S-12	5,400	1
T4S1S-12	491	1
T4S1S-12	16.2	1
T4S1S-13	3,700	1
T4S1S-13	1,410	1
T4S1S-13	210	1
T4S1S-15	344	1
T4S1S-16	403	1
T4S1S-17	290	1
T4S1S-18	41.3	1
T4S1S-19	185	1
T4S1S-7	2,500	1

**Dibenz(a,h)anthracene**

Sample Location	µg/kg	Note
SS-8-1	602	1
SS-8-2	5,010	1
T4S1S-12	1,100	1
T4S1S-12	166	1
T4S1S-12	5.04	1
T4S1S-13	780	1
T4S1S-13	500	1
T4S1S-13	70.1	1
T4S1S-15	117	1
T4S1S-16	142	1
T4S1S-17	99.4	1
T4S1S-18	14.5	1
T4S1S-19	61.6	1
T4S1S-7	660	1

**90% UCL Input Files**

Benzo(a)anthracene - µg/kg	d_Benzo(a)anthracene - µg/kg	Benzo(b)fluoranthene - µg/kg	d_Benzo(b)fluoranthene - µg/kg	Benzo(a)pyrene - µg/kg	d_Benzo(a)pyrene - µg/kg	Indeno(1,2,3-cd)pyrene - µg/kg	d_Indeno(1,2,3-cd)pyrene - µg/kg	Dibenz(a,h)anthracene - µg/kg	d_Dibenz(a,h)anthracene - µg/kg
14.7	0	14.7	0	14.7	0	14.7	0	14.7	0
14.9	0	14.9	0	14.9	0	14.9	0	14.9	0
15.1	0	15.1	0	15.1	0	15.1	0	15.1	0
14.8	0	14.8	0	14.8	0	14.8	0	14.8	0
14.8	0	14.8	0	14.8	0	14.8	0	14.8	0
14.6	0	14.6	0	14.6	0	14.6	0	14.6	0
176	1	237	1	252	1	178	1	58.9	1
93.4	1	123	1	154	1	116	1	31.3	1
46.6	1	67.8	1	72.5	1	57.2	1	16.2	1
5.4	1	5.7	1	7.5	1	5.6	1	1.7	1
34.0	1	54.9	1	52.9	1	37.8	1	12.2	1
31.5	1	33.6	1	43.6	1	29.7	1	7.6	1
85.4	1	171	1	170	1	147	1	45.0	1
190	1	310	1	310	1	390	1	77	1
52	1	92	1	69	1	64	1	330	0
100	1	210	1	150	1	130	1	35	1
210	1	320	1	320	1	330	1	53	1
11	1	15	1	8.9	1	15	1	2.6	1
9	1	16	1	12	1	15	1	2.7	1
24	1	14	1	15	1	12	1	2.6	1
59	1	78	1	84	1	82	1	12	1
66	1	140	1	97	1	84	1	24	1
38	1	61	1	58	1	61	1	13	1
58	1	58	1	53	1	39	1	9.6	1
150	1	230	1	250	1	280	1	39	1
2.1	1	2.1	1	1.8	1	3	1	0.54	1
1.6	1	1.4	1	1.4	1	1.7	1	0.37	1
0.89	1	1.4	1	1.2	1	1.9	1	0.3	1
1.4	1	1.4	1	1.1	1	1.4	1	5	0
1.3	1	1.8	1	1.2	1	2	1	5	0
15	1	24	1	21	1	28	1	5.9	1
1.5	1	1.5	1	2.6	1	2.8	1	4.9	0
10.1	1	18.9	1	16.9	1	8.80	1	15.2	0
5.5	1	7	1	6.1	1	9.5	1	2	1
14.4	0	4.00	1	4.86	1	14.4	0	14.4	0
201	1	326	1	281	1	121	1	43.9	1
31.2	1	59.5	1	47.8	1	25.3	1	12.0	1
19.8	1	40.6	1	32.1	1	25.8	1	7.03	1
383	1	644	1	568	1	242	1	84.7	1

Benzo(a)anthracene - µg/kg	d_Benzo(a)anthracene - µg/kg	Benzo(b)fluoranthene - µg/kg	d_Benzo(b)fluoranthene - µg/kg	Benzo(a)pyrene - µg/kg	d_Benzo(a)pyrene - µg/kg	Indeno(1,2,3-cd)pyrene - µg/kg	d_Indeno(1,2,3-cd)pyrene - µg/kg	Dibenz(a,h)anthracene - µg/kg	d_Dibenz(a,h)anthracene - µg/kg
2,320	1	2,900	1	2,800	1	1,810	1	602	1
14,200	1	20,200	1	19,200	1	13,300	1	5,010	1
3,900	1	6,200	1	6,000	1	5,400	1	1,100	1
998	1	1,830	1	1,310	1	491	1	166	1
14.1	1	20.9	1	20.1	1	16.2	1	5.04	1
2,400	1	3,900	1	3,800	1	3,700	1	780	1
1,300	1	3,060	1	1,760	1	1,410	1	500	1
185	1	323	1	256	1	210	1	70.1	1
446	1	616	1	616	1	344	1	117	1
581	1	1,080	1	830	1	403	1	142	1
358	1	631	1	571	1	290	1	99.4	1
57.3	1	79.5	1	83.8	1	41.3	1	14.5	1
249	1	342	1	354	1	185	1	61.6	1
2,200	1	3,800	1	2,800	1	2,500	1	660	1

**90% UCL Output Files**

### General UCL Statistics for Data Sets with Non-Detects

#### User Selected Options

From File	Table 4.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Benzo(a)anthracene -  $\mu\text{g/kg}$

#### General Statistics

Number of Valid Data	39	Number of Detected Data	32
Number of Distinct Detected Data	32	Number of Non-Detect Data	7
		Percent Non-Detects	17.95%

#### Raw Statistics

	Log-transformed Statistics	
Minimum Detected	0.89 Minimum Detected	-0.117
Maximum Detected	383 Maximum Detected	5.948
Mean of Detected	66.05 Mean of Detected	3.158
SD of Detected	86.02 SD of Detected	1.736
Minimum Non-Detect	14.4 Minimum Non-Detect	2.667
Maximum Non-Detect	15.1 Maximum Non-Detect	2.715

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	20
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	48.72%

#### UCL Statistics

Normal Distribution Test with Detected Values Only	Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.749 Shapiro Wilk Test Statistic	0.936
5% Shapiro Wilk Critical Value	0.93 5% Shapiro Wilk Critical Value	0.93
Data not Normal at 5% Significance Level	Data appear Lognormal at 5% Significance Level	

#### Assuming Normal Distribution

DL/2 Substitution Method	Assuming Lognormal Distribution	
Mean	DL/2 Substitution Method	
SD	55.52 Mean	2.95
90% DL/2 (t) UCL	80.97 SD	1.632
	72.43 90% H-Stat (DL/2) UCL	136.3

#### Maximum Likelihood Estimate(MLE) Method

Mean	Log ROS Method	
SD	9.724 Mean in Log Scale	2.847
90% MLE (t) UCL	126.6 SD in Log Scale	1.711
90% MLE (Tiku) UCL	36.16 Mean in Original Scale	54.97
	41.94 SD in Original Scale	81.32
	90% t UCL	71.95
	90% Percentile Bootstrap UCL	72.9
	90% BCA Bootstrap UCL	75.24
	90% H UCL	148

#### Gamma Distribution Test with Detected Values Only

k star (bias corrected)	Data Distribution Test with Detected Values Only	
Theta Star	0.563 Data appear Gamma Distributed at 5% Significance Level	
nu star	117.2	

#### A-D Test Statistic

5% A-D Critical Value	0.305 Nonparametric Statistics	
K-S Test Statistic	0.801 Kaplan-Meier (KM) Method	
5% K-S Critical Value	0.801 Mean	55.02
Data appear Gamma Distributed at 5% Significance Level	0.163 SD	80.25
	SE of Mean	13.06

Assuming Gamma Distribution	90% KM (t) UCL	72.06
Gamma ROS Statistics using Extrapolated Data	90% KM (z) UCL	71.76
Minimum	90% KM (jackknife) UCL	72.01
Maximum	90% KM (bootstrap t) UCL	76.9
Mean	90% KM (BCA) UCL	72.97
Median	90% KM (Percentile Bootstrap) UCL	72.54
SD	90% KM (Chebyshev) UCL	94.21
k star	81.83 95% KM (Chebyshev) UCL	112
Theta star	0.193 97.5% KM (Chebyshev) UCL	136.6
Nu star	280.3 99% KM (Chebyshev) UCL	185
AppChi2	15.08	
90% Gamma Approximate UCL	8.611 Potential UCL to Use	
90% Adjusted Gamma UCL	94.94 Recommendation Provided only	
	96.64 for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

### Benzo(b)fluoranthene - $\mu\text{g}/\text{kg}$

#### General Statistics

Number of Valid Data	39 Number of Detected Data	33
Number of Distinct Detected Data	31 Number of Non-Detect Data	6
	Percent Non-Detects	15.38%

#### Raw Statistics

	Log-transformed Statistics	
Minimum Detected	1.4 Minimum Detected	0.336
Maximum Detected	644 Maximum Detected	6.468
Mean of Detected	102.1 Mean of Detected	3.441
SD of Detected	140.3 SD of Detected	1.881
Minimum Non-Detect	14.6 Minimum Non-Detect	2.681
Maximum Non-Detect	15.1 Maximum Non-Detect	2.715

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	17
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	22
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	43.59%

#### UCL Statistics

Normal Distribution Test with Detected Values Only	Lognormal Distribution Test with Detected Values Only
Shapiro Wilk Test Statistic	0.731 Shapiro Wilk Test Statistic
5% Shapiro Wilk Critical Value	0.931 5% Shapiro Wilk Critical Value
Data not Normal at 5% Significance Level	Data not Lognormal at 5% Significance Level

#### Assuming Normal Distribution

DL/2 Substitution Method	Assuming Lognormal Distribution
Mean	DL/2 Substitution Method
SD	87.57 Mean
90% DL/2 (t) UCL	1.804
	133.3 SD
	115.4 90% H-Stat (DL/2) UCL
	270.5

#### Maximum Likelihood Estimate(MLE) Method

Mean	Log ROS Method	3.129
SD	24.75 Mean in Log Scale	1.881
90% MLE (t) UCL	196.5 SD in Log Scale	87.09
90% MLE (Tiku) UCL	65.79 Mean in Original Scale	133.6
	72.29 SD in Original Scale	115
	90% t UCL	116.4
	90% Percentile Bootstrap UCL	119.4
	90% BCA Bootstrap UCL	301.8
	90% H UCL	

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.503	Data appear Gamma Distributed at 5% Significance Level
Theta Star	203.2	
nu star	33.18	
A-D Test Statistic	0.407	Nonparametric Statistics
5% A-D Critical Value	0.808	Kaplan-Meier (KM) Method
K-S Test Statistic	0.808	Mean
5% K-S Critical Value	0.162	SD
Data appear Gamma Distributed at 5% Significance Level		SE of Mean
Assuming Gamma Distribution		90% KM (t) UCL
Gamma ROS Statistics using Extrapolated Data		90% KM (z) UCL
Minimum	1.00E-06	90% KM (jackknife) UCL
Maximum	644	90% KM (bootstrap t) UCL
Mean	86.43	90% KM (BCA) UCL
Median	24	90% KM (Percentile Bootstrap) UCL
SD		90% KM (Chebyshev) UCL
k star	134	95% KM (Chebyshev) UCL
Theta star	0.202	97.5% KM (Chebyshev) UCL
Nu star	427.9	99% KM (Chebyshev) UCL
AppChi2	15.75	
90% Gamma Approximate UCL	9.123	Potential UCL to Use
90% Adjusted Gamma UCL	149.2	Recommendation Provided only
	151.8	for 95% Confidence Coeficient

Note: DL/2 is not a recommended method.

#### Benzo(a)pyrene - µg/kg

##### General Statistics

Number of Valid Data	39	Number of Detected Data	33
Number of Distinct Detected Data	32	Number of Non-Detect Data	6
		Percent Non-Detects	15.38%

##### Raw Statistics

Minimum Detected	1.1	Log-transformed Statistics	
Maximum Detected	568	Minimum Detected	0.0953
Mean of Detected	95.95	Maximum Detected	6.342
SD of Detected	129.8	Mean of Detected	3.374
Minimum Non-Detect	14.6	SD of Detected	1.882
Maximum Non-Detect	15.1	Minimum Non-Detect	2.681
		Maximum Non-Detect	2.715

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	18
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	21
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	46.15%

##### UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.743	Shapiro Wilk Test Statistic	0.932
5% Shapiro Wilk Critical Value	0.931	5% Shapiro Wilk Critical Value	0.931
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

##### Assuming Normal Distribution

DL/2 Substitution Method		Assuming Lognormal Distribution	
Mean	82.33	Mean	3.163
SD	123.5	SD	1.798
90% DL/2 (t) UCL	108.1	90% H-Stat (DL/2) UCL	251.7

Maximum Likelihood Estimate(MLE) Method	Log ROS Method	
Mean	17.46 Mean in Log Scale	3.08
SD	188.6 SD in Log Scale	1.867
90% MLE (t) UCL	56.86 Mean in Original Scale	81.88
90% MLE (Tiku) UCL	64.2 SD in Original Scale	123.7
	90% t UCL	107.7
	90% Percentile Bootstrap UCL	108.7
	90% BCA Bootstrap UCL	111.8
	90% H UCL	276.3
Gamma Distribution Test with Detected Values Only	Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.501 Data appear Gamma Distributed at 5% Significance Level	
Theta Star	191.4	
nu star	33.09	
A-D Test Statistic	0.396 Nonparametric Statistics	
5% A-D Critical Value	0.808 Kaplan-Meier (KM) Method	
K-S Test Statistic	0.808 Mean	81.89
5% K-S Critical Value	0.162 SD	122.1
Data appear Gamma Distributed at 5% Significance Level	SE of Mean	19.86
	90% KM (t) UCL	107.8
Assuming Gamma Distribution	90% KM (z) UCL	107.3
Gamma ROS Statistics using Extrapolated Data	90% KM (jackknife) UCL	107.7
Minimum	1.00E-06 90% KM (bootstrap t) UCL	115.8
Maximum	568 90% KM (BCA) UCL	106
Mean	81.19 90% KM (Percentile Bootstrap) UCL	107.7
Median	21 90% KM (Chebyshev) UCL	141.5
SD	124.2 95% KM (Chebyshev) UCL	168.5
k star	0.202 97.5% KM (Chebyshev) UCL	205.9
Theta star	401.4 99% KM (Chebyshev) UCL	279.5
Nu star	15.78	
AppChi2	9.14 Potential UCL to Use	
90% Gamma Approximate UCL	140.1 Recommendation Provided only	
90% Adjusted Gamma UCL	142.6 for 95% Confidence Coefcient	

Note: DL/2 is not a recommended method.

### Indeno(1,2,3-cd)pyrene - $\mu\text{g}/\text{kg}$

General Statistics		
Number of Valid Data	39 Number of Detected Data	32
Number of Distinct Detected Data	31 Number of Non-Detect Data	7
	Percent Non-Detects	17.95%
Raw Statistics	Log-transformed Statistics	
Minimum Detected	1.4 Minimum Detected	0.336
Maximum Detected	390 Maximum Detected	5.966
Mean of Detected	79.58 Mean of Detected	3.36
SD of Detected	102.4 SD of Detected	1.684
Minimum Non-Detect	14.4 Minimum Non-Detect	2.667
Maximum Non-Detect	15.1 Maximum Non-Detect	2.715
Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	20
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	48.72%

UCL Statistics		
Normal Distribution Test with Detected Values Only	Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.758 Shapiro Wilk Test Statistic	0.943
5% Shapiro Wilk Critical Value	0.93 5% Shapiro Wilk Critical Value	0.93
Data not Normal at 5% Significance Level	Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution	Assuming Lognormal Distribution	
DL/2 Substitution Method	DL/2 Substitution Method	
Mean	66.62 Mean	3.115
SD	96.68 SD	1.611
90% DL/2 (t) UCL	86.81 90% H-Stat (DL/2) UCL	153.3
Maximum Likelihood Estimate(MLE) Method	Log ROS Method	
Mean	10.37 Mean in Log Scale	3.039
SD	152.9 SD in Log Scale	1.676
90% MLE (t) UCL	42.29 Mean in Original Scale	66.19
90% MLE (Tiku) UCL	49.25 SD in Original Scale	96.95
	90% t UCL	86.44
	90% Percentile Bootstrap UCL	86.63
	90% BCA Bootstrap UCL	90
	90% H UCL	165.1
Gamma Distribution Test with Detected Values Only	Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.571 Data appear Gamma Distributed at 5% Significance Level	
Theta Star	139.5	
nu star	36.52	
A-D Test Statistic	0.337 Nonparametric Statistics	
5% A-D Critical Value	0.801 Kaplan-Meier (KM) Method	
K-S Test Statistic	0.801 Mean	66.2
5% K-S Critical Value	0.163 SD	95.71
Data appear Gamma Distributed at 5% Significance Level	SE of Mean	15.57
	90% KM (t) UCL	86.51
Assuming Gamma Distribution	90% KM (z) UCL	86.16
Gamma ROS Statistics using Extrapolated Data	90% KM (jackknife) UCL	86.45
Minimum	1.00E-06 90% KM (bootstrap t) UCL	92.96
Maximum	390 90% KM (BCA) UCL	86.35
Mean	65.29 90% KM (Percentile Bootstrap) UCL	85.68
Median	25.3 90% KM (Chebyshev) UCL	112.9
SD	97.55 95% KM (Chebyshev) UCL	134.1
k star	0.193 97.5% KM (Chebyshev) UCL	163.5
Theta star	339.1 99% KM (Chebyshev) UCL	221.2
Nu star	15.02	
AppChi2	8.563 Potential UCL to Use	
90% Gamma Approximate UCL	114.5 Recommendation Provided only	
90% Adjusted Gamma UCL	116.6 for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

### Dibenz(a,h)anthracene - µg/kg

General Statistics		
Number of Valid Data	39 Number of Detected Data	27
Number of Distinct Detected Data	25 Number of Non-Detect Data	12
	Percent Non-Detects	30.77%
Raw Statistics	Log-transformed Statistics	
Minimum Detected	0.3 Minimum Detected	-1.204
Maximum Detected	84.7 Maximum Detected	4.439

Mean of Detected	22.23	Mean of Detected	2.237
SD of Detected	24.36	SD of Detected	1.619
Minimum Non-Detect	4.9	Minimum Non-Detect	1.589
Maximum Non-Detect	330	Maximum Non-Detect	5.799
Note: Data have multiple DLs - Use of KM Method is recommended For all methods (except KM, DL/2, and ROS Methods), Observations < Largest ND are treated as NDs		Number treated as Non-Detect Number treated as Detected Single DL Non-Detect Percentage	39 0 100.00%
<b>UCL Statistics</b>			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.827	Shapiro Wilk Test Statistic	0.932
5% Shapiro Wilk Critical Value	0.923	5% Shapiro Wilk Critical Value	0.923
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	21.33	Mean	2.161
SD	31.92	SD	1.468
90% DL/2 (t) UCL	27.99	90% H-Stat (DL/2) UCL	43.3
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	1.868
		SD in Log Scale	1.478
		Mean in Original Scale	16.36
		SD in Original Scale	22.05
		90% t UCL	20.97
		90% Percentile Bootstrap UCL	20.92
		90% BCA Bootstrap UCL	21.46
		90% H-UCL	33.05
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.647	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	34.38		
nu star	34.91		
A-D Test Statistic	0.295	Nonparametric Statistics	
5% A-D Critical Value	0.789	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.789	Mean	16.99
5% K-S Critical Value	0.176	SD	21.87
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	3.639
Assuming Gamma Distribution		90% KM (t) UCL	21.74
Gamma ROS Statistics using Extrapolated Data		90% KM (z) UCL	21.66
Minimum	1.00E-06	90% KM (jackknife) UCL	21.72
Maximum	84.7	90% KM (bootstrap t) UCL	22.98
Mean	16.46	90% KM (BCA) UCL	21.84
Median	7.03	90% KM (Percentile Bootstrap) UCL	21.72
SD	22.09	90% KM (Chebyshev) UCL	27.91
k star	0.286	95% KM (Chebyshev) UCL	32.85
Theta star	57.47	97.5% KM (Chebyshev) UCL	39.72
Nu star	22.35	99% KM (Chebyshev) UCL	53.2
AppChi2	14.32	Potential UCL to Use	
90% Gamma Approximate UCL	25.69	Recommendation Provided only	
90% Adjusted Gamma UCL	26.06	for 95% Confidence Coeficient	

Note: DL/2 is not a recommended method.

### General UCL Statistics for Data Sets with Non-Detects

#### User Selected Options

From File	Table 5.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Benzo(a)anthracene -  $\mu\text{g}/\text{kg}$

#### General Statistics

Number of Valid Observations	14 Number of Distinct Observations	14
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#### Raw Statistics

	Log-transformed Statistics	
Minimum	14.1 Minimum of Log Data	2.646
Maximum	14200 Maximum of Log Data	9.561
Mean	2086 Mean of log Data	6.494
Median	789.5 SD of log Data	1.793
SD	3673	
Std. Error of Mean	981.5	
Coefficient of Variation	1.76	
Skewness	3.15	

#### Relevant UCL Statistics

Normal Distribution Test	Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.564 Shapiro Wilk Test Statistic	0.974
Shapiro Wilk Critical Value	0.874 Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level	Data appear Lognormal at 5% Significance Level	

#### Assuming Normal Distribution

	Assuming Lognormal Distribution	
90% Student's-t UCL	3412 90% H-UCL	14776
	90% Chebyshev (MVUE) UCL	6843
90% UCLs (Adjusted for Skewness)	95% Chebyshev (MVUE) UCL	8764
90% Adjusted-CLT UCL (Chen-1995)	3934 97.5% Chebyshev (MVUE) UCL	11429
90% Modified-t UCL (Johnson-1978)	3549 99% Chebyshev (MVUE) UCL	16666

#### Gamma Distribution Test

k star (bias corrected)	0.476 Data appear Gamma Distributed at 5% Significance Level
Theta Star	4382

#### MLE of Mean

MLE of Mean	2086	
MLE of Standard Deviation	3024	
nu star	13.33	
Approximate Chi Square Value (.05)	7.288 Nonparametric Statistics	
Adjusted Level of Significance	0.0781 90% CLT UCL	3344
Adjusted Chi Square Value	6.83 90% Jackknife UCL	3412
	90% Standard Bootstrap UCL	3286
Anderson-Darling Test Statistic	0.299 90% Bootstrap-t UCL	6042
Anderson-Darling 5% Critical Value	0.789 90% Hall's Bootstrap UCL	9193
Kolmogorov-Smirnov Test Statistic	0.146 90% Percentile Bootstrap UCL	3287
Kolmogorov-Smirnov 5% Critical Value	0.241 90% BCA Bootstrap UCL	4080
Data appear Gamma Distributed at 5% Significance Level	90% Chebyshev(Mean, Sd) UCL	5031
	95% Chebyshev(Mean, Sd) UCL	6365
	97.5% Chebyshev(Mean, Sd) UCL	8216
Assuming Gamma Distribution	99% Chebyshev(Mean, Sd) UCL	11853

#### 90% Approximate Gamma UCL

#### 90% Adjusted Gamma UCL

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

### Benzo(b)fluoranthene - $\mu\text{g/kg}$

#### General Statistics

Number of Valid Observations

14 Number of Distinct Observations

14

#### Raw Statistics

Minimum

#### Log-transformed Statistics

20.9 Minimum of Log Data 3.04

Maximum

20200 Maximum of Log Data 9.913

Mean

3213 Mean of log Data 6.968

Median

1455 SD of log Data 1.818

SD

5225

Std. Error of Mean

1396

Coefficient of Variation

1.626

Skewness

3.002

#### Relevant UCL Statistics

Normal Distribution Test

#### Lognormal Distribution Test

Shapiro Wilk Test Statistic

0.602 Shapiro Wilk Test Statistic

0.961

Shapiro Wilk Critical Value

0.874 Shapiro Wilk Critical Value

0.874

Data not Normal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

#### Assuming Normal Distribution

90% Student's-t UCL

#### Assuming Lognormal Distribution

5098 90% H-UCL 25804

90% UCLs (Adjusted for Skewness)

90% Chebyshev (MVUE) UCL

11491

90% Adjusted-CLT UCL (Chen-1995)

95% Chebyshev (MVUE) UCL

14733

90% Modified-t UCL (Johnson-1978)

5803 97.5% Chebyshev (MVUE) UCL

19233

5285 99% Chebyshev (MVUE) UCL 28072

#### Gamma Distribution Test

#### Data Distribution

k star (bias corrected)

0.49 Data appear Gamma Distributed at 5% Significance Level

Theta Star

6553

MLE of Mean

3213

MLE of Standard Deviation

4589

nu star

13.73

Approximate Chi Square Value (.05)

7.585 Nonparametric Statistics

Adjusted Level of Significance

0.0781 90% CLT UCL

5003

Adjusted Chi Square Value

7.117 90% Jackknife UCL

5098

90% Standard Bootstrap UCL

4972

Anderson-Darling Test Statistic

0.251 90% Bootstrap-t UCL

8241

Anderson-Darling 5% Critical Value

0.788 90% Hall's Bootstrap UCL

13841

Kolmogorov-Smirnov Test Statistic

0.134 90% Percentile Bootstrap UCL

4951

Kolmogorov-Smirnov 5% Critical Value

0.241 90% BCA Bootstrap UCL

5892

Data appear Gamma Distributed at 5% Significance Level

90% Chebyshev(Mean, Sd) UCL

7402

95% Chebyshev(Mean, Sd) UCL

9300

97.5% Chebyshev(Mean, Sd) UCL

11934

99% Chebyshev(Mean, Sd) UCL

17107

#### Assuming Gamma Distribution

90% Approximate Gamma UCL

5815

90% Adjusted Gamma UCL

6197

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

### Benzo(a)pyrene - $\mu\text{g}/\text{kg}$

#### General Statistics

Number of Valid Observations

14 Number of Distinct Observations

13

#### Raw Statistics

Minimum

Log-transformed Statistics

3.001

Maximum

20.1 Minimum of Log Data

9.863

Mean

19200 Maximum of Log Data

6.833

Median

2886 Mean of log Data

1.778

SD

1070 SD of log Data

4997

Std. Error of Mean

1335

Coefficient of Variation

1.732

Skewness

3.061

#### Relevant UCL Statistics

Normal Distribution Test

Lognormal Distribution Test

0.979

Shapiro Wilk Test Statistic

0.58 Shapiro Wilk Test Statistic

0.979

Shapiro Wilk Critical Value

0.874 Shapiro Wilk Critical Value

0.874

Data not Normal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

#### Assuming Normal Distribution

90% Student's-t UCL

Assuming Lognormal Distribution

19761

4689 90% H-UCL

9363

90% UCLs (Adjusted for Skewness)

90% Chebyshev (MVUE) UCL

11982

90% Adjusted-CLT UCL (Chen-1995)

95% Chebyshev (MVUE) UCL

15619

90% Modified-t UCL (Johnson-1978)

5377 97.5% Chebyshev (MVUE) UCL

22761

4871 99% Chebyshev (MVUE) UCL

#### Gamma Distribution Test

Data Distribution

k star (bias corrected)

0.481 Data appear Gamma Distributed at 5% Significance Level

Theta Star

5999

MLE of Mean

2886

MLE of Standard Deviation

4161

nu star

13.47

Approximate Chi Square Value (.05)

7.392 Nonparametric Statistics

Adjusted Level of Significance

0.0781 90% CLT UCL

4597

Adjusted Chi Square Value

6.93 90% Jackknife UCL

4689

90% Standard Bootstrap UCL

4451

Anderson-Darling Test Statistic

0.271 90% Bootstrap-t UCL

8099

Anderson-Darling 5% Critical Value

0.789 90% Hall's Bootstrap UCL

12609

Kolmogorov-Smirnov Test Statistic

0.119 90% Percentile Bootstrap UCL

4627

Kolmogorov-Smirnov 5% Critical Value

0.241 90% BCA Bootstrap UCL

5553

Data appear Gamma Distributed at 5% Significance Level

90% Chebyshev(Mean, Sd) UCL

6892

95% Chebyshev(Mean, Sd) UCL

8707

97.5% Chebyshev(Mean, Sd) UCL

11226

99% Chebyshev(Mean, Sd) UCL

16173

#### Assuming Gamma Distribution

90% Approximate Gamma UCL

5259

90% Adjusted Gamma UCL

5609

#### Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002).

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

### Indeno(1,2,3-cd)pyrene - $\mu\text{g/kg}$

#### General Statistics

Number of Valid Observations

14 Number of Distinct Observations

14

#### Raw Statistics

Minimum

#### Log-transformed Statistics

2.785

Maximum

16.2 Minimum of Log Data

9.496

Mean

13300 Maximum of Log Data

6.404

Median

2150 Mean of log Data

1.87

SD

447 SD of log Data

3587

Std. Error of Mean

958.5

1.668

Coefficient of Variation

1.668

Skewness

2.66

#### Relevant UCL Statistics

Normal Distribution Test

#### Lognormal Distribution Test

0.975

Shapiro Wilk Test Statistic

0.634 Shapiro Wilk Test Statistic

0.874

Shapiro Wilk Critical Value

0.874 Shapiro Wilk Critical Value

0.874

Data not Normal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

#### Assuming Normal Distribution

90% Student's-t UCL

#### Assuming Lognormal Distribution

17546

3444 90% H-UCL

7177

90% UCLs (Adjusted for Skewness)

90% Chebyshev (MVUE) UCL

9223

90% Adjusted-CLT UCL (Chen-1995)

3865 97.5% Chebyshev (MVUE) UCL

12063

90% Modified-t UCL (Johnson-1978)

3558 99% Chebyshev (MVUE) UCL

17642

#### Gamma Distribution Test

#### Data Distribution

k star (bias corrected)

0.441 Data appear Gamma Distributed at 5% Significance Level

Theta Star

4877

#### MLE of Mean

2150

MLE of Standard Deviation

3238

nu star

12.34

Approximate Chi Square Value (.05)

6.557 Nonparametric Statistics

Adjusted Level of Significance

0.0781 90% CLT UCL

3378

Adjusted Chi Square Value

6.126 90% Jackknife UCL

3444

90% Standard Bootstrap UCL

3325

Anderson-Darling Test Statistic

0.364 90% Bootstrap-t UCL

5168

Anderson-Darling 5% Critical Value

0.793 90% Hall's Bootstrap UCL

8555

Kolmogorov-Smirnov Test Statistic

0.204 90% Percentile Bootstrap UCL

3384

Kolmogorov-Smirnov 5% Critical Value

0.242 90% BCA Bootstrap UCL

3751

Data appear Gamma Distributed at 5% Significance Level

90% Chebyshev(Mean, Sd) UCL

5026

95% Chebyshev(Mean, Sd) UCL

6328

97.5% Chebyshev(Mean, Sd) UCL

8136

99% Chebyshev(Mean, Sd) UCL

11687

#### Assuming Gamma Distribution

90% Approximate Gamma UCL

4048

90% Adjusted Gamma UCL

4333

#### Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Dibenz(a,h)anthracene -  $\mu\text{g}/\text{kg}$

General Statistics

Number of Valid Observations	14 Number of Distinct Observations	14
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Raw Statistics

	Log-transformed Statistics	
Minimum	5.04 Minimum of Log Data	1.617
Maximum	5010 Maximum of Log Data	8.519
Mean	666.3 Mean of log Data	5.241
Median	154 SD of log Data	1.806
SD	1296	
Std. Error of Mean	346.3	
Coefficient of Variation	1.945	
Skewness	3.316	

Relevant UCL Statistics

Normal Distribution Test	Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.518 Shapiro Wilk Test Statistic	0.972
Shapiro Wilk Critical Value	0.874 Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level	Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution

	Assuming Lognormal Distribution	
90% Student's-t UCL	1134 90% H-UCL	4420
	90% Chebyshev (MVUE) UCL	2004
90% UCLs (Adjusted for Skewness)	95% Chebyshev (MVUE) UCL	2568
90% Adjusted-CLT UCL (Chen-1995)	1329 97.5% Chebyshev (MVUE) UCL	3351
90% Modified-t UCL (Johnson-1978)	1185 99% Chebyshev (MVUE) UCL	4888

Gamma Distribution Test

k star (bias corrected)	0.443 Data appear Gamma Distributed at 5% Significance Level
Theta Star	1503

MLE of Mean	666.3	
MLE of Standard Deviation	1001	
nu star	12.41	
Approximate Chi Square Value (.05)	6.605 Nonparametric Statistics	
Adjusted Level of Significance	0.0781 90% CLT UCL	1110
Adjusted Chi Square Value	6.172 90% Jackknife UCL	1134
	90% Standard Bootstrap UCL	1089
Anderson-Darling Test Statistic	0.485 90% Bootstrap-t UCL	2275
Anderson-Darling 5% Critical Value	0.793 90% Hall's Bootstrap UCL	3161
Kolmogorov-Smirnov Test Statistic	0.191 90% Percentile Bootstrap UCL	1083
Kolmogorov-Smirnov 5% Critical Value	0.242 90% BCA Bootstrap UCL	1376
Data appear Gamma Distributed at 5% Significance Level	90% Chebyshev(Mean, Sd) UCL	1705
	95% Chebyshev(Mean, Sd) UCL	2176
	97.5% Chebyshev(Mean, Sd) UCL	2829
Assuming Gamma Distribution	99% Chebyshev(Mean, Sd) UCL	4112
90% Approximate Gamma UCL	1252	
90% Adjusted Gamma UCL	1340	

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.